

Streamflow Effects – Sierran Meadow Restoration Projects

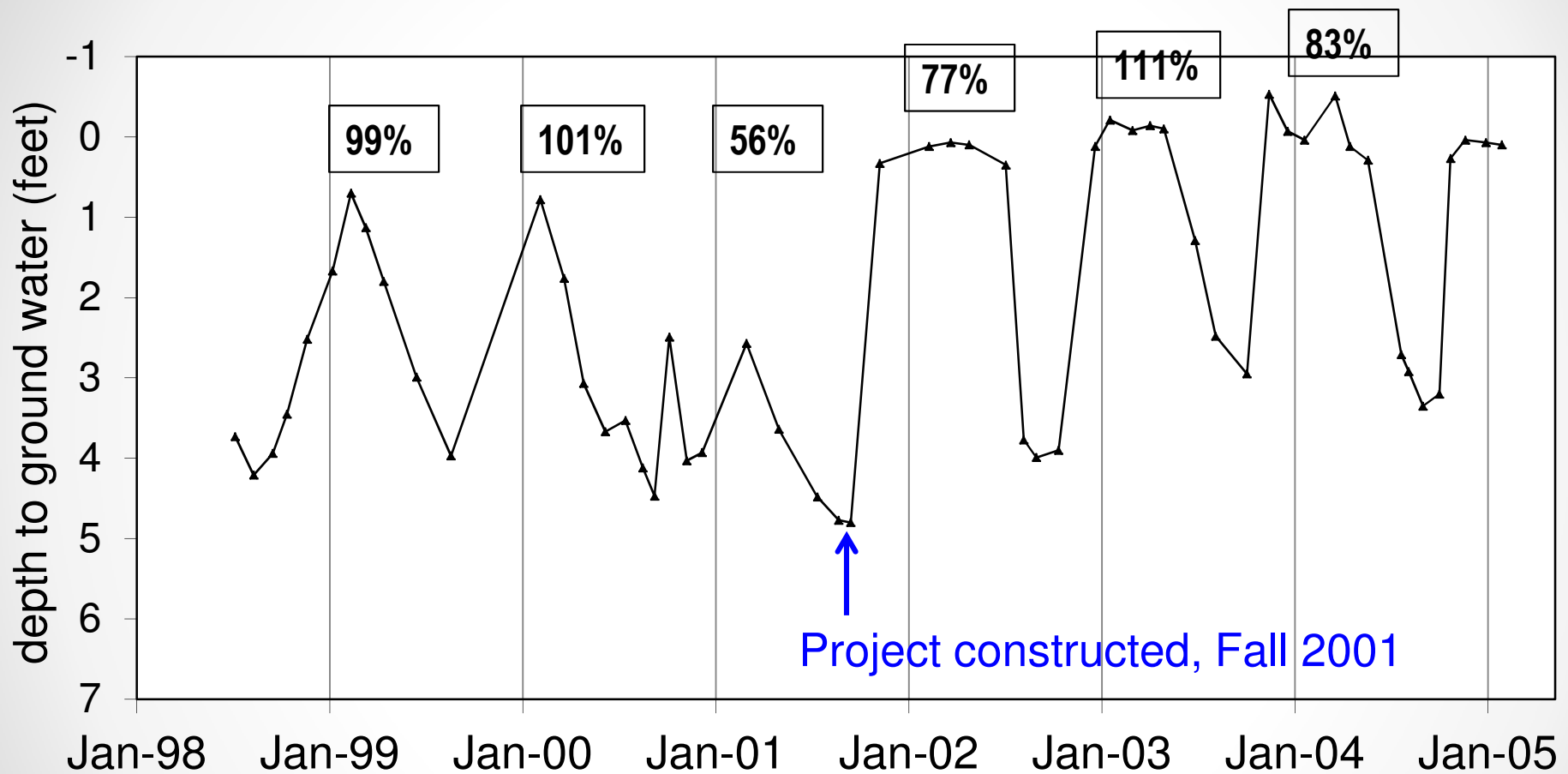
A Review of Local Studies and Published Literature



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Clark's Creek Meadow – 2005

Cornwell & Brown, CSU-Sacramento, 2008



- Restoration increased groundwater retention
- Retained groundwater is released through the summer

• Note: Precipitation is shown for each year as a percentage of average annual precipitation •²

Last Chance Creek - 2005

**Assessment of the Restoration Activities on
Water Balance and Water Quality at Last
Chance Creek Watershed Using Watershed
Environmental Hydrology (WEHY) Model**

M.L. Kavvas, Z. Q. Chen, M. Anderson, L. Liang, N. Ohara
Hydrologic Research Laboratory,
Civil and Environmental Engineering, UC Davis

J. Wilcox, L. Mink, T. Benoit
Feather River CRM

Last Chance Creek – 2005

Kavvas, UC-Davis, WEHY Flow Model Results

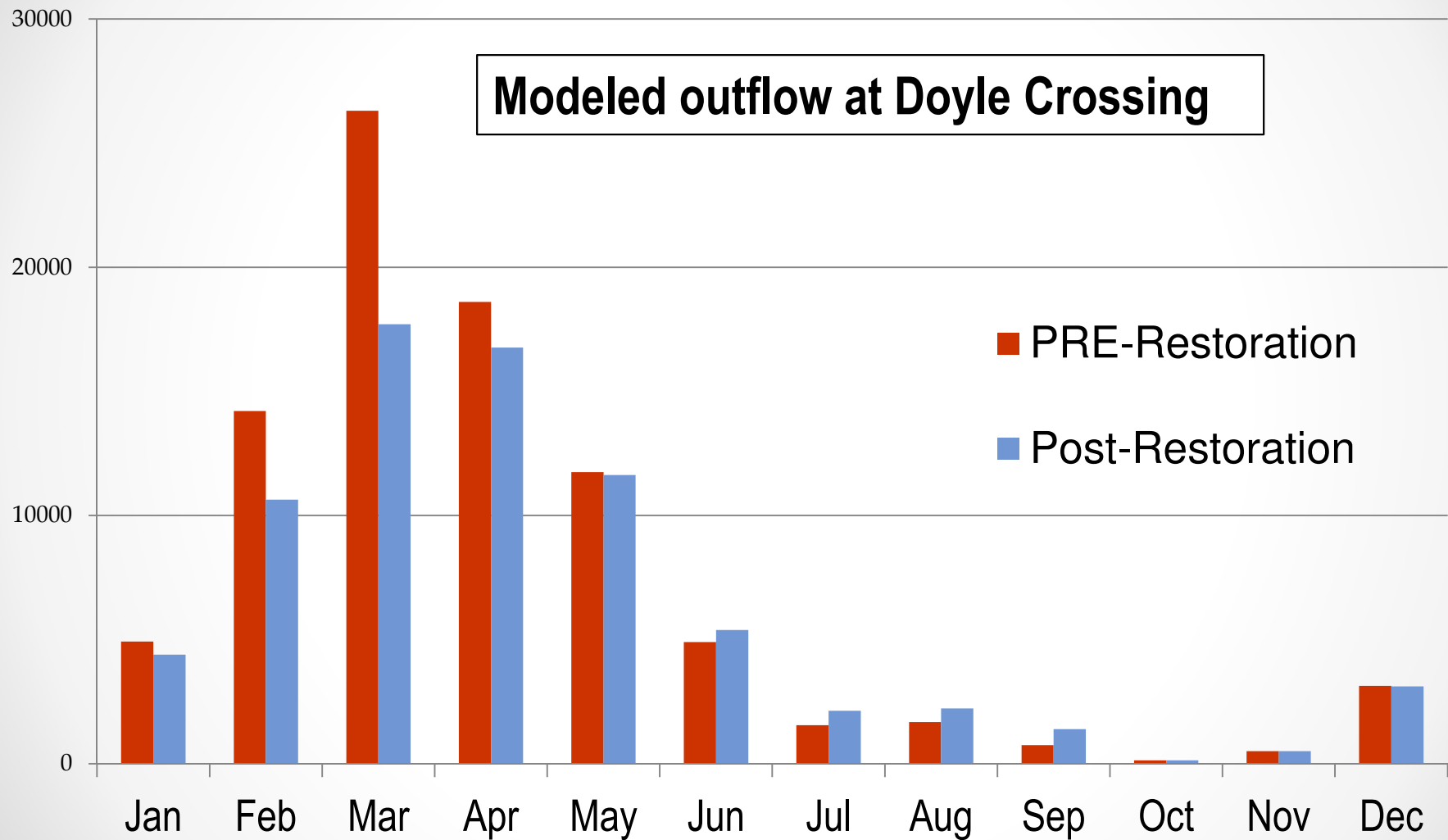
Monthly Flow at the Doyle Crossing (Oct. 1982-Sep.1983)

	Pre-restoration (acre-ft)	Post-restoration (acre-ft)	absolute diff (acre-ft)	relative diff (%)
Oct	132	132	0	0.00
Nov	505	499	-5	-1.06
Dec	3133	3109	-24	-0.77
Jan	4916	4388	-528	-10.74
Feb	14204	10631	-3574	-25.16
Mar	26302	17709	-8594	-32.67
Apr	18600	16762	-1838	-9.88
May	11744	11628	-116	-0.99
Jun	4898	5386	488	9.97
Jul	1545	2129	584	37.82
Aug	1680	2222	542	32.38
Sep	749	1393	643	85.84
Annual	88408	75988	-12420	-14.05

Note: Modeled flow values are for first season after construction (while meadow is filling) and are for an exceptionally wet water year

Last Chance Creek – 2005

Kavvas, UC-Davis, WEHY Flow Model Results for 1983



Note the size of each monthly flow difference

Last Chance Creek – 2005

Loheide, Stanford Univ, Evapotranspiration Field Study & Model



Evapotranspiration rate in a restored meadow is roughly twice the rate of an eroded meadow

- (5-7 mm/day versus 2-4 mm/day)

Bear Creek Meadow, Lassen Co. – 2005

Hammersmark, Rains, Mount, UC-Davis – Flow Model Results

Model predicted a shortening of the base flow season of 2 weeks within the project area

Modeled baseflow levels increased downstream of the restored reach

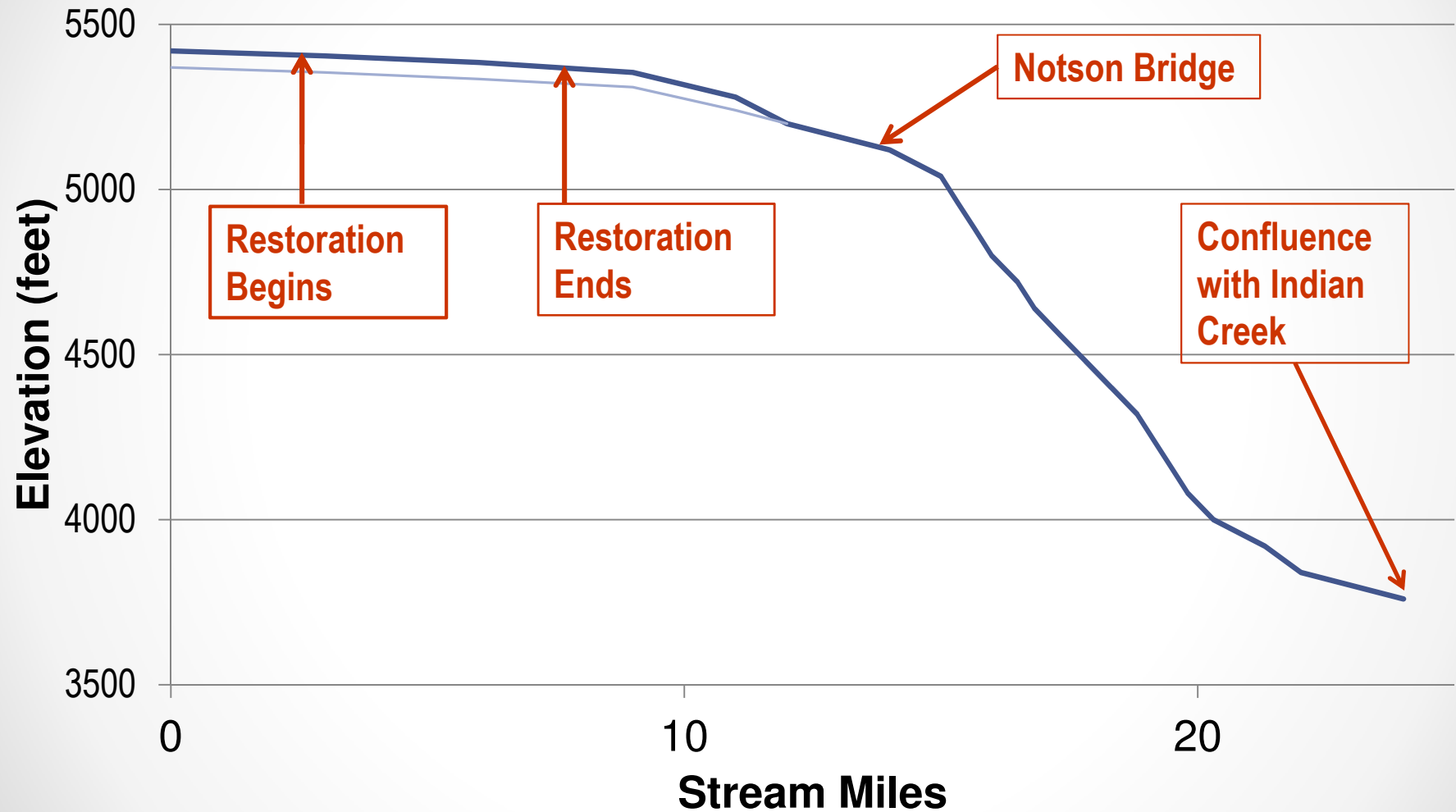
Due to evapotranspiration and increased downstream groundwater flow (parallel to the stream)

An exceptionally porous layer in the soils of this project area



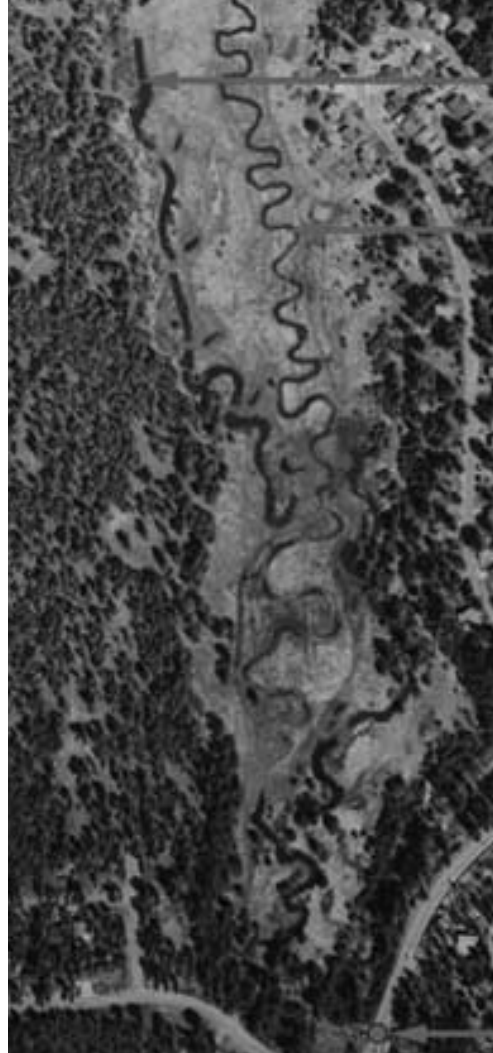
Red Clover Creek

Approximate Stream Profile



Trout Creek (near Lake Tahoe) – 2008

Tague, Valentine, Kotchen, UC-Santa Barbara – gage analysis



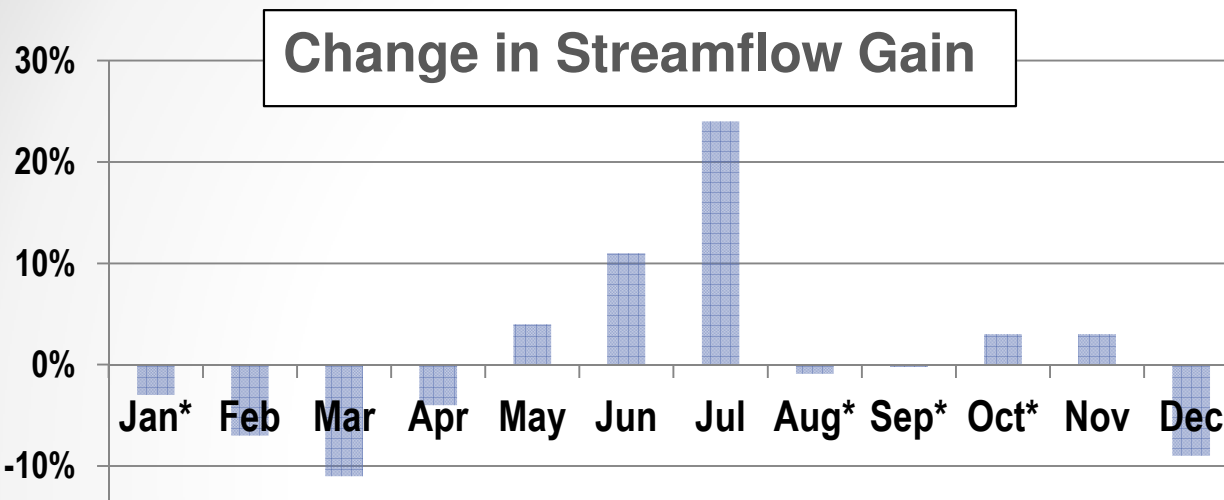
Analyzed changes in streamflow gain before and after a 1.9 mile long pond-and-plug project

USGS gages located upstream and downstream of the project

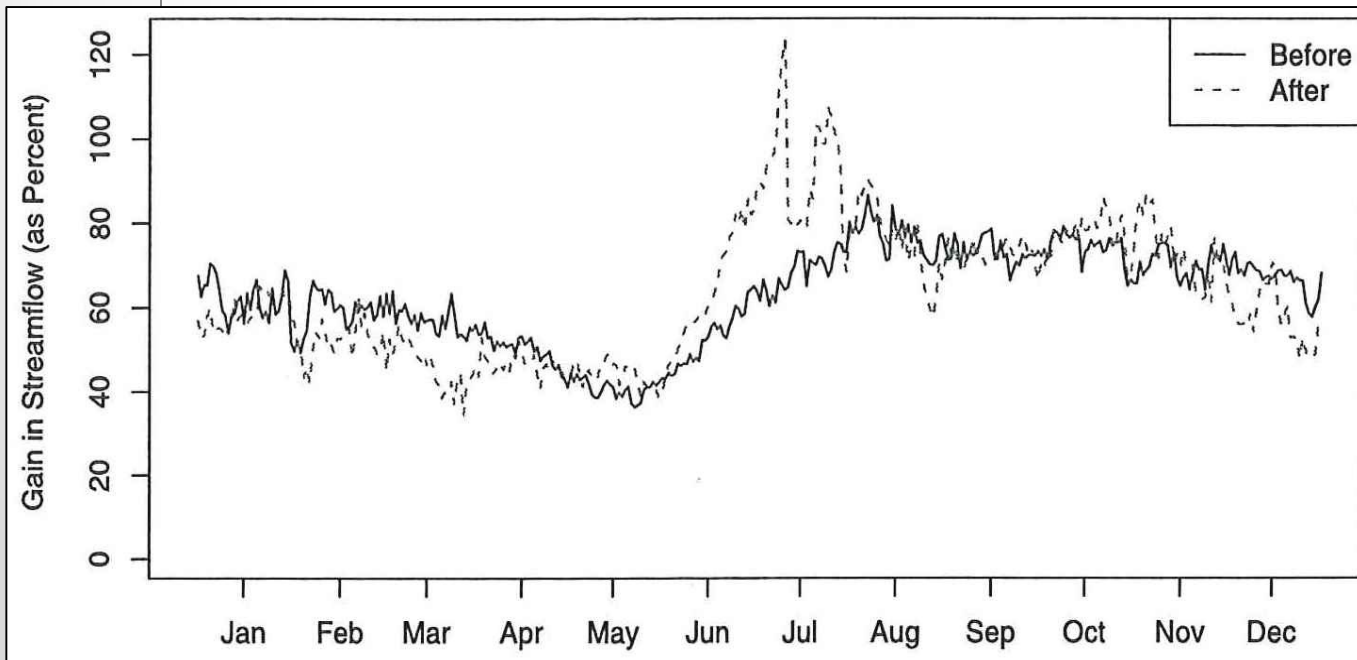
Gages in operation since 1960 (downstream) and 1990 (upstream)

Trout Creek (near Lake Tahoe) – 2008

Tague, Valentine, Kotchen, UC-Santa Barbara – gage analysis



Statistically significant increase in streamflow gain (4% to 24%) for early summer months (snowmelt recession period)



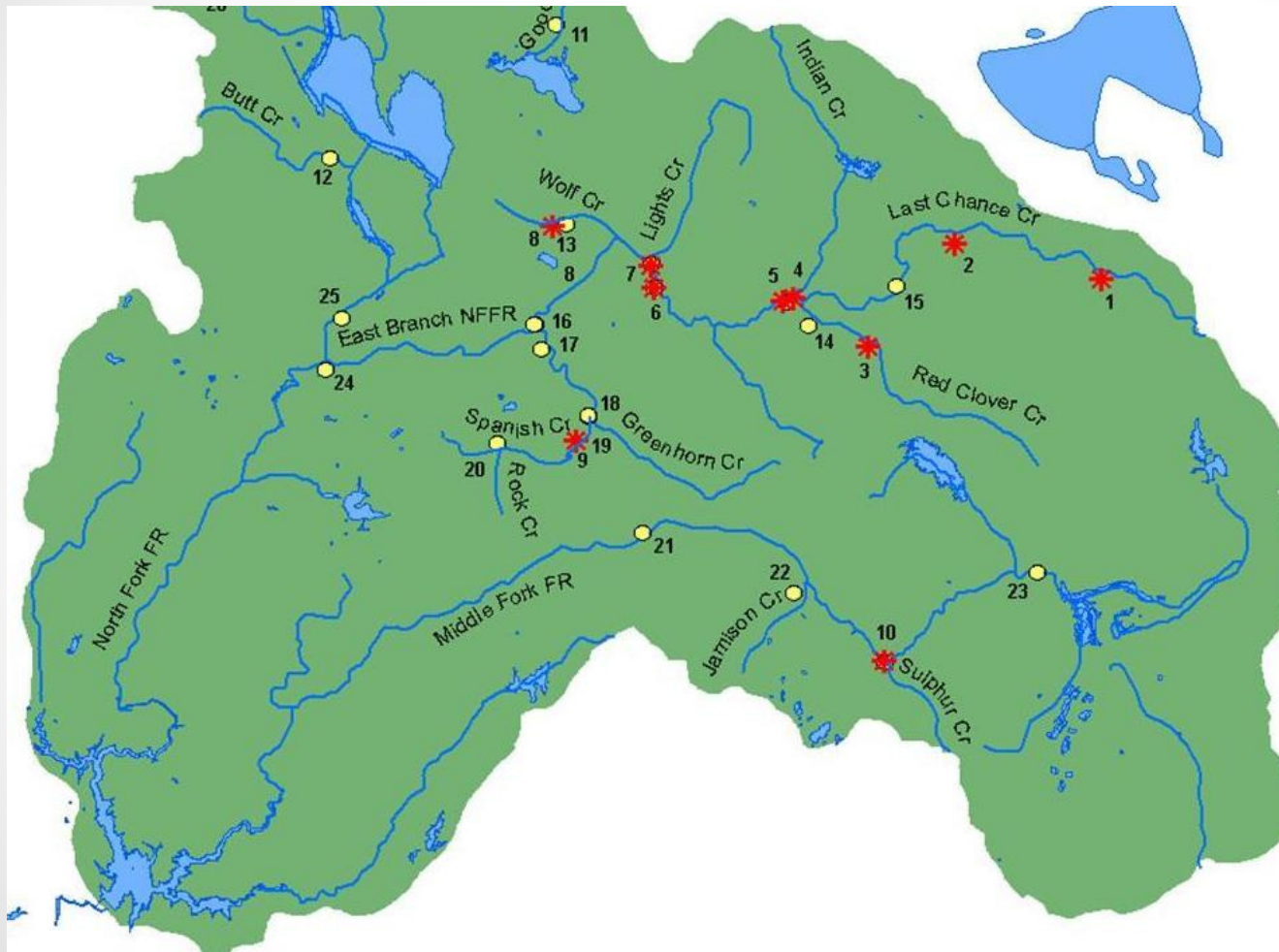
No observed change in late season base flow

Decreases in streamflow gain during winter and peak snowmelt

* - change is not statistically significant

Red Clover, Last Chance Creeks – 2011

Cawley: Analysis of Low Flow Season (May-Sept)



Moving average analysis to look for trends in streamflow during low flow season

Data is normalized for effects of precipitation from May - Sept

Streamflow continuously recorded from 2000 through 2010 (with data gaps of just 2% - 5%)

Red Clover, Last Chance Creeks – 2011

Cawley: Analysis of Low Flow Season (May-Sept)

Finding: No apparent statistical trend for streamflow during the low flow season, either in positive or negative direction



Last Chance Creek

- Gage at Doyle Crossing
- Roughly 9 miles of meadow restoration upstream (1 mile since 2005, with 8 miles proposed)

Red Clover Creek

- Gage at Notson Bridge
- Roughly 10 miles of meadow restoration upstream (8 miles since 2005)

Analysis limited by short period of record at the gages (11 years)

- and distance from restoration projects (small changes in low flows) ●₁₂

Cottonwood Creek (Big Flat) – 2011

Cawley: Analysis of Low Flow Season (May-Sept)

12 years of flow data for gages located above and below the treated meadow

Approximately $\frac{3}{4}$ mile long

A statistically significant difference in mean daily flow for the two gages, suggesting a possible low flow augmentation of about 10% for late, May, June, and part of July (flow is not perennial)



Other Papers (not pond-n-plug): 1979-1990

- Heede (1979) – restoration of gullies in Colorado using check dams and range management improvements restored perennial flow within 7 years
- Ponce and Lindquist (1990) – Several examples of western mountain meadows where restoration, primarily with check dams, converted ephemeral channels to perennial flow
- Swanson, Franzen, and Manning (1987) – Meadow restoration with check dams in northwestern Nevada transformed about one mile of intermittent flow to perennial flow

Wrap-Up and Questions



● Note: All photos in this presentation courtesy of Jim Wilcox and Feather River CRM staff